

April - September 1961

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NORTHEASTERN FOREST EXPERIMENT STATION

Division of Watershed Management Research

Semi-annual Report

October 1961

GENERAL

We have had considerable help in the past few months. Herb Storey, Ed Johnson, and John Hewlett, along with Bill Lucas and Frank Paradise from R-7 came to our program review at the Fernow in June. Henry Anderson and Jake Kovner reviewed Reigner's single-watershed calibration; Hoover-Goodell-Aldon, Storey, and Ed Johnson reviewed the Pierce and Reinhart weir-construction opus. Well-reviewed, we are now revising: for as usual, your comments--patient, pointed, and profane--were most helpful.

In this report we introduce a new project--Syracuse. With the help of Hal Wilm and considerable cooperation from the New York State University School of Forestry, Art Eschner moved September 1 from the Fernow to Syracuse to start a cooperative watershed research project in New York state. Art is working with Don Satterlund, Professor of Forest Influences.

In another cooperative venture Bill Sopper, Penn State's watershed management professor, Howard Lull (sp?) and Bob Hobba of the WO joined forces for an analysis of selected USGS streamflow records in the Northeast.

A minor triumph--we put the Upper Darby watershed reference file under the Oxford system, finding enough holes in it to plug in our far-flung subject matters. It's good for filing. The question we may answer in our next semi-annual is how it is for finding.

ELKINS RESEARCH CENTER

Major effort in the period went into preparations for publications. These included two versions of Effect on Streamflow of Four Forest Practices in the Appalachian Mountains, one scheduled for publication in the Journal of Geophysical Research and the other a Station Paper. Manuscript of Stream-gaging Stations for Research on Small Watersheds, a joint effort with the Laconia Center, was also revised during the period.

In June, a meeting was held in Parsons to review the Watershed Management Research Program--past, present and future. In addition to personnel of the Northeastern Station, representatives of the Washington Office, Southeastern and Central States Stations and R-7 participated. We are now trying to digest their comments and come up with a revised Center program.

The loss about September 1 of Art Eschner has hit us hard. He has gone to Syracuse to initiate a cooperative watershed research program with the New York State University College of Forestry.

We should have quit when we were ahead. Streamflow characteristics of the Original Fernow Five, gaged since 1951, were quite similar. The four watersheds added since are showing some unexplained differences of considerable magnitude. We are studying the records for a better understanding of the situation. We don't know where the answer lies but may have to go underground to find them--perhaps in the field of geology.

LACONIA RESEARCH CENTER

The large watertight concrete boxes with sharp-crested V-notch weirs that we have built in the past at Hubbard Brook are quite costly and time-consuming to construct. Further, when flows exceed the V-notch discharge becomes complex and can be only roughly estimated. To our knowledge, discharge curves have not been developed for flow under these circumstances.

To overcome these disadvantages, we constructed this summer a combined small V-notch weir and San Dimas flume. The idea is not new, as San Dimas has had them in operation. However, the modifications we have made, and the fact that these are being tried in an extremely cold climate are worthy of mention here. Figure 1 is a plan view of the gaging station.

Figure 1.--Plan view of combined V-notch weir and San Dimas flume.

Low flows pass through the flume, then into a trough which leads to the basin, and finally over the V-notch blade. High flows pass through the flume and over the flume end jumping clear of the trough. Low flows up to 2.5 cfs will be measured through the 1-foot-high 90° V-notch weir. The 3-foot San Dimas will take over for flows from 2.5 cfs to a maximum of about 80 cfs. An FW-1 recorder will measure discharge from the V-notch and a Fisher-Porter analog-digital recorder will measure flow through the flume. The FW-1 recorder will run continuously, whereas the battery-operated analog-digital recorder will be activated by a microswitch when flows exceed the V-notch. The ponding basin of the weir is small enough to be covered in winter to restrict ice formation.

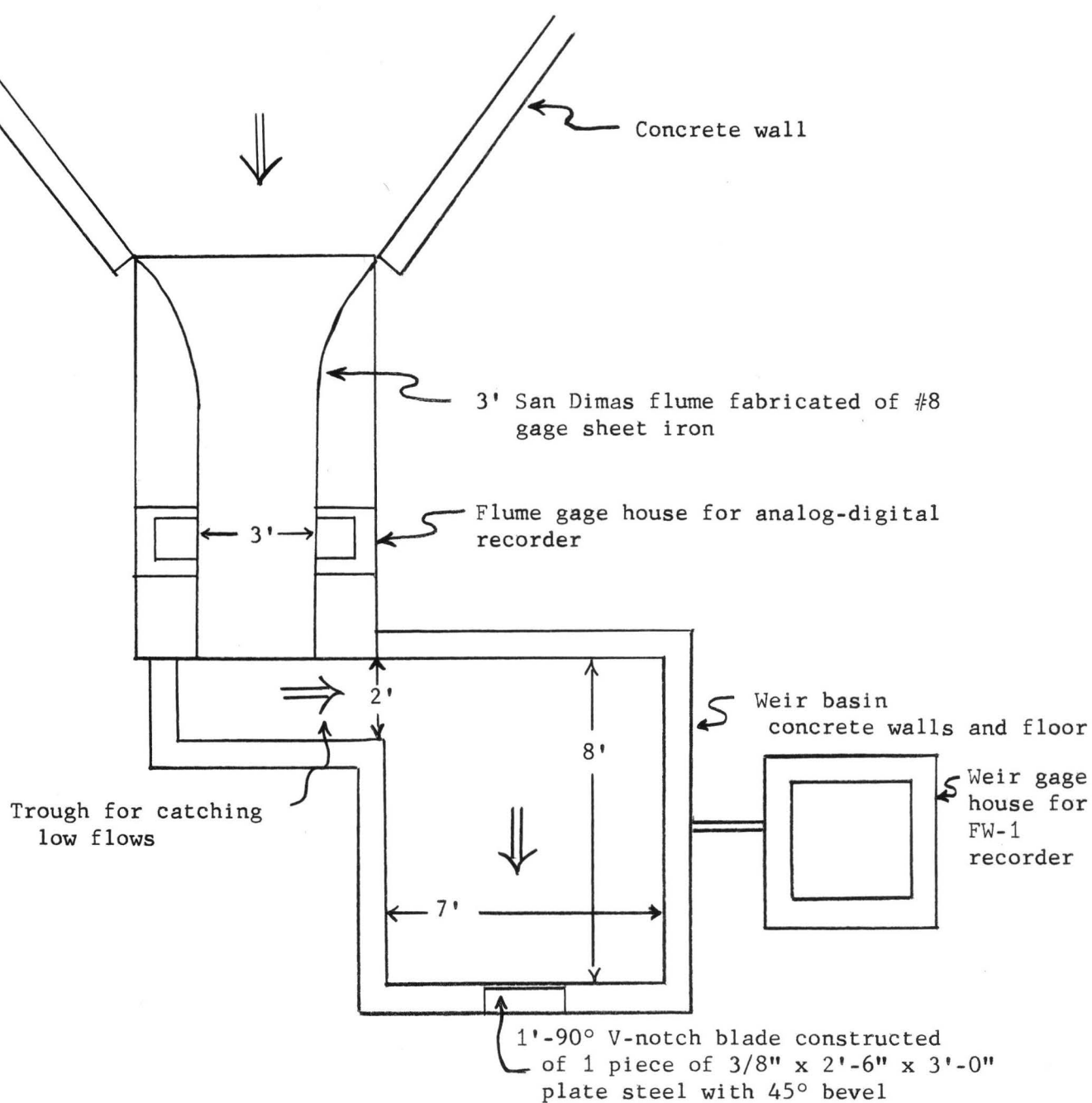


Figure 1.--Plan view of combined V-notch weir and San Dimas Flume.

Developing Rating Curves for V-Notch Weirs

In field rating our sharp-crested V-notch weirs for low flows a V-shaped metal trough is fastened to the metal-plate blade by means of C-clamps and pressure of its own weight. This trough is so placed on the blade that it does not interfere with normal discharge. The trough leads into a funnel which concentrates the flow, and reduces splash. Water discharging from the funnel is caught, during a measured time-period, in a galvanized, open-top, watering tank 6 feet in diameter by 2 1/2 feet in height. At the start of a measuring period, this tank is inserted under the water discharging funnel, and water is allowed to flow into the tank until the desired depth in the tank is about reached. Flow into the tank from the funnel is stopped by inserting a plywood board or light sheet metal between the tank and funnel. The amount of water in the tank is determined by:

- a. Measuring total depth of water in the tank, multiplied by the cross-sectional area of the tank (this system may be used if the tank walls are rigid).
- b. Drawing water from the tank and measuring it in small calibrated vessels.

By this scheme we have been able to measure flows up to about 2.5 cfs. For greater flows a Pygmy Current Meter is used in the stream channel directly below the weir.

Hexadecanol and Transpiration

At the last AGU meeting a paper was presented by Roberts of the Illinois State Water Survey Division, Urbana, Illinois on the influence of hexadecanol on retarding evapotranspiration of corn and grass plants. Following his lead, we tried a small-scale study on four tree species native to this area: sugar maple, white ash, white pine, and balsam fir. 2-0 stock tree seedlings were used. Roberts found that additions of hexadecanol to the soil seemed to reduce transpiration. We did not find this. This trial will be repeated next summer with different rates of application. We noticed, however, that there are a multitude of different types of fatty alcohols (hexadecanol) and thus the organic formula may play a major part in whether or not this material can be taken up by the plant and lodged in the leaf tissues. In this respect, unless someone happens to hit it lucky, several thousand trials may be needed to test all presently available forms of fatty alcohol for possible transpiration reduction in plants.

Building Plans

We are finally to have a permanent headquarters at Hubbard Brook. Plans for an office-field assistants quarters, now on the drawing board, are a far cry from our present trailer operations.

Personnel

Our staff will be cut by one man for the next two years, as George Hart has returned to the University of Michigan for graduate studies leading to a Ph.D.

NEW LISBON RESEARCH CENTER

Quite a bit of time was spent on the single-watershed calibration: writing a long station paper and revising the one submitted to the Journal of Geophysical Research. The latter was reviewed critically, by a number of people within and outside of the U. S. Forest Service.

Penn State Watersheds

In April, Lull and Reigner met Fletcher and Sopper, from Penn State, in the offices of the Pennsylvania Department of Forests and Waters. The latter department was represented by Ralph Wible and Joe Ibberson, and the three cooperating organizations quickly agreed to enlarge the watershed management research facilities on Penn State's Stone Valley Forest. Specifically, three watersheds on shale soils will be gaged and calibrated as soon as possible, to supplement the three Leading Ridge Watersheds located on sandstone parent material.

Sopper and Reigner did most of the planning and, with advice from many people including Dick Sartz of the Lake States Station and Jim Smith of our Washington office staff, decided to install two weirs and one flume-weir combination. The flume was new to us, so we travelled to Beltsville, Md. where Mr. L. L. Kelly of ARS showed us one of their H-type flumes.

In August two wooden box-type weirs were constructed, similar to the one completed on the Baltimore watershed two years previously. One of them was lined with vinyl plastic, which has been successful at Baltimore; the other was lined with butyl rubber (much heavier and approximately 3 1/2 times as expensive as the vinyl). A comparison of the weathering qualities of these liners will be an interesting by-product of the study. Both weirs have sharp-crested V-notch blades of rather unique designs. One has a shallow 30-degree notch at the bottom of the V, abruptly flaring to 150 degrees at a height of 0.3 feet. Its narrow notch is quite sensitive at low flows; its 150-degree notch will contain a rather high flow. The other blade has a parabolic shape similar to a Columbus deep-notch weir. Pete Dress, the Forestry School's statistician, designed the parabola and

devised a theoretical rating curve.

The flume-weir combination is located on a 120-acre watershed. To carry the expected high flows, an HL flume, 4 1/2 feet high, was constructed of redwood; it has a 16-foot approach of Douglas-fir. As the HL flume is relatively insensitive at low flows, a small weir with a 1-foot, 60-degree notch was constructed downstream from the flume.

Newark Watersheds

On the Newark (N.J.) watersheds we are having trouble in obtaining accurate water-yield data. Not only have we discovered leaks in two of the concrete weirs, but water is apparently being lost by underflow from the largest of the three watersheds into an adjacent drainage not included in the study. One of the boundaries of this study watershed lies very close to the stream channel, and only a few feet higher. Apparently the groundwater ridge recedes below the stream channel, allowing groundwater to flow laterally away from the channel. In any event, the streamflow in this channel drops to zero long before flow in the smallest watershed ceases. The middle-size watershed has permanent flow.

Groundwater investigations are being continued to verify our suspicions, but it appears now that nothing can be done to contain the flow within this watershed.

The leaks in the concrete weir boxes are not serious, but we have attempted to seal them, using bentonite. As the leaks appeared to be at the joint between the walls and floor, bentonite was spread on the concrete floor and sloped up to the sides of the box. By the next report, we should be able to discuss effect of this treatment.

Baltimore Watersheds

Here, too, a leak has been bothering us--this in one of the two concrete-block weir boxes. A year ago we tried asphalt cement, but it did not seal the leak. This summer we installed a vinyl-plastic liner similar to the one installed in the wooden weir on the adjacent watershed.

Serial Correlation

As intimated in the introduction to this section, the single-watershed calibration has been criticized on a number of points. One of them was the use of serially-correlated data: i.e., data which overlapped earlier data. Obviously, a year beginning in July would not be independent of a year beginning in June of the same calendar year. Runoff, precipitation, and some of the other variables involved would be serially correlated.

Applying the Hart-von Neumann test to the simple relationship between annual runoff and precipitation using consecutive hydrologic years, serial correlation is quite evident. But after adding climatic variables related to antecedent conditions, and an annual temperature variable, the test shows that serial correlation is no longer involved. This test is in general use in Econometrics. Economic researchers have also devised means of using first differences to eliminate the effects of serial correlation.

SYRACUSE

The month of September saw Art Eschner, who doesn't actually wear a hat, with three figurative chapeaux. The initiation of a cooperative watershed management research program between the Northeastern Station and the State University of New York, College of Forestry at Syracuse University calls for activities as a cooperator, student, and to a limited extent, faculty member.

Most of Eschner's time this first month has been spent in getting acquainted; with the College, its facilities for watershed management research, and with the literature pertinent to the preparation of a problem analysis for the program.

PUBLICATIONS

A city manages its forested watershed lands. Walter C. Sushko and Irvin C. Reigner. Jour. Soil and Water Conservation 16: 119-122, 1961.

Further observations of snow and frost in the Adirondacks. Howard W. Lull and Francis M. Rushmore. Northeast. Forest Expt. Sta. Note 116, 4 pp., 1961.

The problem of stones in soil-moisture measurement. K. G. Reinhart. Soil Sci. Soc. of Amer. Proc. 25: 268-270, 1961.

Net precipitation in a northern hardwood forest. Raymond E. Leonard. Jour. Geophys. Research 66: 2417-2421, 1961.

Forest and watershed project. Delaware-Lehigh Experimental Forest, Report No. 4. Irvin C. Reigner, W. E. McQuilkin, E. F. McNamara. Penna. Dept. of Forests and Waters, 97 pp., illus., 1961.

Water management--one of the multiple uses of forest land. G. R. Trimble, Jr., Virginia Tech. Forester 1961, 5 pp.

Manuscripts Submitted

Comparative influence of hardwood trees, litter, and a bare area on the soil-moisture regimen. Peter W. Fletcher and Howard W. Lull.

Effect on streamflow of four forest practices in the mountains of West Virginia. K. G. Reinhart, A. R. Eschner, and G. R. Trimble, Jr.

Solar radiation in forestry. William E. Reifsnyder and Howard W. Lull.